Long-term outcomes of the Coordinated Care Program in Patients after Myocardial Infarction (KOS-MI)

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ABSTRACT

Background: The Coordinated Care in Myocardial Infarction Program (KOS-MI) was introduced to improve prognosis for patients after myocardial infarction (MI). The program includes complete revascularization followed by unrestricted access to rehabilitation, electrotherapy, and cardiac care.

Aim: This study aimed to assess major adverse cardiac and cerebrovascular events (MACCE) of patients enrolled in the KOS-MI at 3-year follow-up.

Methods: This is a retrospective, multicenter registry of patients treated for MI. The study group (KOS-MI) of 963 patients was compared to the control group (standard care) of 1009 patients. At 3-year follow-up, MACCE including death, MI, stroke, and repeated revascularization were reported. Additionally, hospitalization for heart failure (HF) was analyzed. Propensity score matching (PSM) was utilized for group baseline characteristic adjustment.

Results: Patients in the KOS-MI group were younger (65 vs. 68 years; P <0.001), mostly men (70% vs. 62.9%; P <0.001), admitted with ST-segment elevation myocardial infarction (STEMI) (44.6% vs. 36.2%; P <0.001). Patients in the control group had more comorbidities and were admitted more often with non-ST-segment elevation myocardial infarction (63.8% vs. 55.4%; P <0.001) and acute HF (5.1% vs. 2.7%; P = 0.007). Following PSM, 530 well matched pairs were selected. At three years (92.3% follow-up completeness), the relative risk reduction was: 25% in MACCE (P = 0.008), 38% in mortality (P = 0.008), 29% in repeated revascularization (P = 0.04), and 28% (P = 0.0496) in hospitalization for HF in the KOS-MI group.

Conclusions: The combination of contemporary invasive techniques, complete revascularization, cardiac rehabilitation, and ambulatory care included in the KOS-MI Program improves long-term prognosis of patients after MI in 3-year follow-up.

Key words: cardiac rehabilitation, cardiovascular prevention, myocardial infarction

WHAT'S NEW?

The Coordinated Care in Myocardial Infarction Program is an unrestricted, secondary prevention program for patients after myocardial infarction, which provides contemporary percutaneous coronary procedures to achieve complete revascularization, electrotherapy if needed, cardiac rehabilitation, and ambulatory care for one year. Although the program is intended for one year, herein we report improved patient prognosis for up to 3 years. The best effect of the program was achieved in patients with acute ST-segment elevation myocardial infarction, aged <65 years, with ejection fraction below 30%, and atrial fibrillation. Thanks to improved patient outcomes, the program expansion and popularity in Poland are growing.

INTRODUCTION

Cardiovascular diseases are the leading cause of death in developed countries [1]. In Poland, they are responsible for 46% of all deaths [2]. Despite the significant progress in interventional cardiology, the annual mortality rate after myocardial infarction (MI) treated invasively remains high [3]. It is related to insufficient cardiac rehabilitation, lack of complete revascularization, limited access to cardiologists, lack of control of cardiovascular risk factors, and non-compliance with medical and behavioral recommendations [4, 5]. It has been demonstrated that cardiac rehabilitation (CR) and frequent medical follow-up reduce mortality [6–8]. Furthermore, long-term use of prescribed medications and adherence to behavioral recommendations reduce the rate of recurrent cardiovascular events [9]. Since 2017, Poland's National Health Fund and the Ministry of Health have introduced the Coordinated Care in Myocardial Infarction Program (KOS-MI) to achieve complete revascularization, adequate electrotherapy, cardiac rehabilitation, and to facilitate access to cardiologists for patients after MI. One-year results showed a significant improvement in patients who completed the KOS-MI Program. However, whether this positive effect persists after program termination at one year is undetermined. This study aimed to assess 3-year outcomes of the KOS-MI patients and to compare them with the control group that received standard care.

METHODS

This is a retrospective, observational, multicenter registry of consecutive 2084 patients hospitalized for MI in four centers of the American Heart of Poland (Dąbrowa Górnicza, Tychy, Bielsko-Biała, Ustroń) from November 1, 2017 to November 14, 2018. Some data were collected prospectively as noted below. The definition of myocardial infarction was based on the third universal definition of myocardial infarction [10]. Patients who died in the hospital (n = 21) or were transmitted to the Intensive Care Unit (n = 91) were excluded from the analysis. According to the program design, patients who were qualified for coronary artery bypass graft surgery with simultaneous valve surgery were excluded from the program. Also, patients with MI hospitalized directly before in other wards were excluded. Informed consent was obtained from each patient. The study group consisted of 963 patients enrolled in the KOS-MI Program. The control group included 1009 patients who refused to participate in the KOS-MI and received standard care. Rehabilitation, second-stage procedures, and ambulatory care were offered per standard protocol and availability. Figure 1 presents the study flowchart.

The methods of the KOS-MI Program have been described before [4]. The first module includes unrestricted invasive treatment of MI. Subsequently, an individual care plan for a patient is established. The second module comprises CR, either outpatient or in-hospital, depending on patient comorbidities and the presence of heart failure (HF). Individualized training is accompanied by psychological and educational programs. The third module consists of device implantation or electrotherapy in eligible patients. The last module consists of outpatient cardiac care, which includes a minimum of 3 appointments with a cardiologist. The number of visits is unlimited. The module ends with a final follow-up visit, which includes making a summary of the patient's condition and laboratory tests.

All analyses were performed according to the intention-to-treat protocol. All-cause mortality was considered the primary endpoint of this study. The secondary composite endpoint of major adverse cardiac and cerebrovascular events (MACCE) incorporated all-cause death, MI, stroke, and repeated revascularization. Additionally, subsequent hospitalization for decompensation of HF was analyzed.

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the Ethics Committee of the Beskid Medical Chamber in Bielsko-Biala (no. 2020/11/5/2).

Baseline medical information was collected from the hospital information system and prospectively collected KOS-MI records. Follow-up data were obtained from the Polish Registry of Acute Coronary Syndromes based on National Health Fund Data and complementary patient phone calls.

Data were censored on March 15, 2021, and the median observation time was presented in the results.

Statistical analysis

Numerical data were expressed as mean and standard deviation or median and interquartile range (IQR). Categorical variables were presented as absolute numbers and percentages. The Chi^2 test was used for comparison of categorical data, while Student's t-test or the Mann-Whitney test were used for numerical data depending on the distribution. Sur-

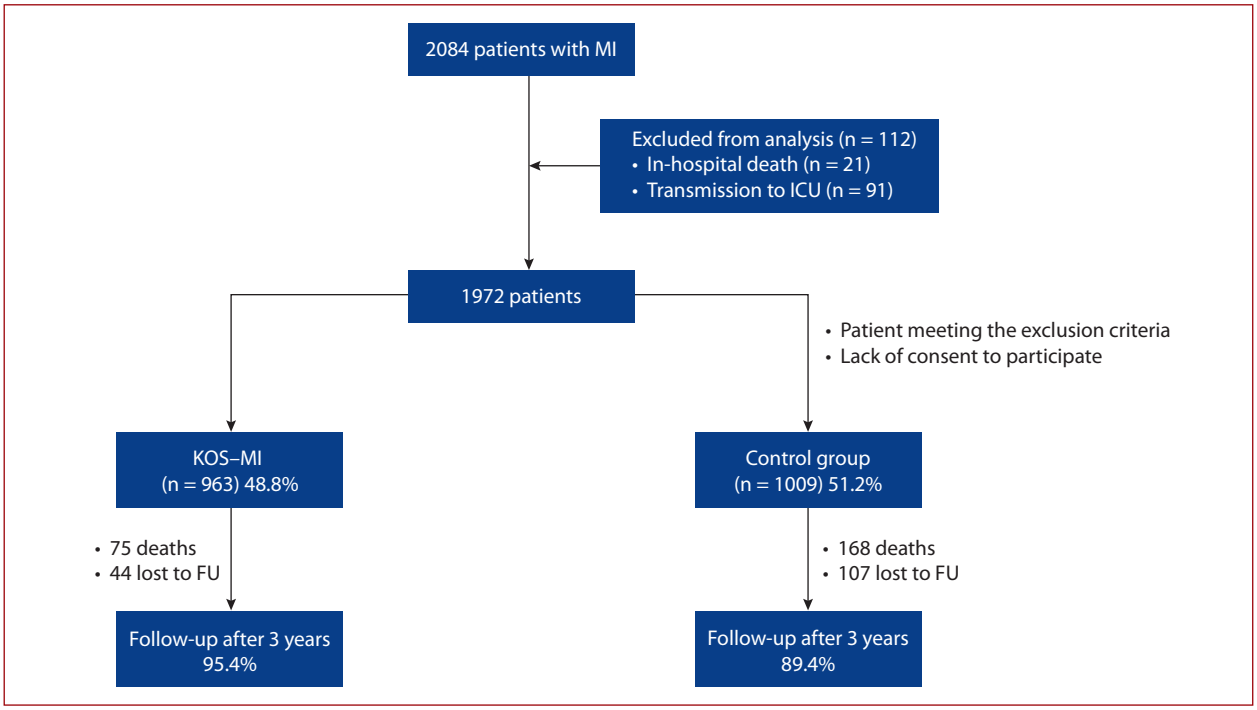

Figure 1. Flowchart of patient recruitment for the study

Abbreviations: FU, follow-up; ICU, intensive care unit; MI, myocardial infarction

vival and event-free survival curves were estimated using Kaplan-Meier analysis with a log-rank test for comparison of curves. A *P*-value of 0.05 or less was considered statistically significant. Because of the nonrandomized nature of the study, propensity score matching (PSM) analysis was utilized to adjust for differences in patients' baseline characteristics. The logistic regression model predicting assignment to the KOS-MI and control groups was utilized. Matching was performed by randomly selecting a KOS-MI patient and looking for the control patient with the nearest logit-transformed propensity score. The standardized difference was calculated for all baseline covariates. Model discrimination was assessed with c-statistics. Using estimated rates of survival in patients undergoing the KOS-MI Program and in those from the control group, we calculated hazard ratios (HR) and 95% confidence intervals (CI). Subgroup analysis after PSM was performed to define the factors affecting the occurrence of all-cause mortality favoring the KOS-MI or the control group.

RESULTS

Baseline patient characteristics

The detailed demographic and clinical characteristics are presented in Table 1. In general, individuals in the KOS-MI group were younger, more often male, and suffering from dyslipidemia. ST-segment elevation myocardial infarction (STEMI) was the dominant diagnosis in the KOS-MI group. On the other hand, patients in the control group presented more frequently with multiple comorbidities: chronic kidney disease, previous MI, and atrial fibrillation (AF). They had more often prior percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) performed. Clinically, patients in the control group more often presented with non-ST-segment elevation myocardial infarction (NSTEMI) and acute HF on admission. In unadjusted analysis, invasive treatment was performed in nearly all cases, however, more frequently in the KOS-MI group. There was higher complexity of coronary artery disease in the control group. In the KOS-MI group, complete revascularization was obtained more regularly. Following PSM, 530 well-matched pairs were selected, and bias reduction was achieved among all unbalanced parameters at baseline.

Long-term outcomes

Complete follow-up was achieved in 92.3% of patients. The median observation time was 2.8 years (IQR, 2.6–3.1). There was a significant reduction in events in the KOS-MI group in terms of MACCE (HR, 0.50; 95% CI, 0.41–0.59; P <0.001), death (HR, 0.41; 95% CI, 0.32–0.53; P <0.001), MI (HR, 0.61; 95% CI, 0.43–0.86; P = 0.005), repeated revascularization (HR, 0.60; 95% CI, 0.46–0.79; P <0.001) and hospitalization for HF decompensation (HR, 0.61; 95% CI, 0.47–0.79; P <0.001) before adjustment (Figure 2). Implantable cardioverter-defibrillator or defibrillator with cardiac resynchronization therapy was implanted in 2.7% of patients in the KOS-MI and 2.2% of patients in the control group (P = 0.49).

The KOS-MI Program was completed by 79% of patients in the study group. Of all patients participating in the pro-

Table 1. Baseline patient characteristics in the unmatched groups

	Control group (n = 1009)	KOS-MI (n = 963)	*P*-value
Age, median (IQR)	68 (61–77)	65 (58–72)	<0.001
Male sex, n (%)	635 (62.9)	677 (70.3)	<0.001
STEMI/ /NSTEMI, n (%)	365 (36.2)/ /644 (63.8)	430 (44.7)/ /533 (55.4)	<0.001
Killip I, II, n (%)	963 (95.4)	936 (97.2)	0.04
Killip III, n (%)	15 (1.5)	7 (0.7)	0.1
Killip IV, n (%)	31 (3.1)	20 (2.1)	0.16
Acute HF, n (%)	51 (5.1)	26 (2.7)	0.007
Congestive HF, n (%)	169 (16.8)	213 (22.1)	0.003
Ejection fraction, %, median (IQR)	48 (40–55)	46 (40–54)	0.40
Acute kidney injury, n (%)	16 (1.6)	8 (0.8)	0.13
Chronic kidney disease, n (%)	108 (10.7)	46 (4.8)	<0.001
Hypertension, n (%)	694 (68.8)	639 (66.4)	0.25
Diabetes mellitus, n (%)	278 (27.6)	226 (23.5)	0.04
Dyslipidemia, n (%)	597 (59.2)	632 (65.6)	0.003
Active smoking, n (%)	217 (21.5)	230 (23.9)	0.21
COPD, n (%)	40 (3.96)	32 (3.3)	0.45
Prior MI, n (%)	186 (18.4)	123 (12.8)	<0.001
Prior PCI, n (%)	165 (16.4)	109 (11.3)	0.001
Prior CABG, n (%)	62 (6.1)	34 (3.5)	0.007
History of stroke, n (%)	51 (5.1)	22 (2.3)	0.001
Atrial fibrillation, n (%)	125 (12.4)	82 (8.5)	0.005
Eptifibatide, n (%)	400 (39.6)	462 (48.0)	<0.001
Coronary angiography, n (%)	966 (95.7)	958 (99.5)	<0.001
PCI, n (%)	810 (80.3)	837 (86.9)	<0.001
CABG, n (%)	59 (5.9)	86 (8.9)	0.009
LM disease, n (%)	108 (10.7)	85 (8.8)	0.16
Multivessel disease, n (%)	682 (68.1)	600 (62.4)	0.007
CTO, n (%)	105 (10.4)	91 (9.5)	0.48
IVUS, n (%)	22 (2.2)	23 (2.4)	0.76
FFR, n (%)	6 (0.6)	7 (0.7)	0.72
Complete revascularization during first hospitalization, n (%)	329 (32.8)	442 (46.0)	<0.001
Staged PCI after primary MI, n (%)	116 (85.3)	128 (91.4)	0.11
Complete revascularization after two stages, n (%)	421 (42.0)	543 (56.6)	<0.001

Abbreviations: CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; CTO, chronic total occlusion; FFR, fractional flow reserve; HF, heart failure; IQR, interquartile range; IVUS, intravascular ultrasound; LM, left main; MI, myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; STEMI, ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention

gram, 90% took part in the rehabilitation. In the control group, only 22.7% of patients were rehabilitated (P <0.001). Patients who finished the KOS-MI Program had at least 3 ambulatory appointments with a cardiologist including the last summary visit. Eighty-nine point nine percent of patients in the KOS-MI group had at least one ambulatory visit and in the control group only 43.1% (P <0.001).

Baseline patient characteristics and angiographic data after PSM were well-balanced and did not differ in any variables (Table 2). Figure 3 shows the long-term outcomes after PSM. There was a significant reduction in MACCE (HR, 0.71; 95% CI, 0.55–0.91; P = 0.008), death (HR, 0.60; 95% CI, 0.41–0.87; P = 0.008), repeated revascularization (HR, 0.69; 95% CI, 0.48–0.99; P = 0.04), and hospitalization for HF decompensation (HR, 0.70; 95% CI, 0.49–1.0; P = 0.0496) in the KOS-MI group.

After PSM, 89.6% of patients in the KOS-MI group participated in the rehabilitation and in the control group — 27.1% of patients (P <0.001). At least one ambulatory visit was performed in 90.6% of patients in the KOS-MI group and 44.6% in the control group (P <0.001).

The subgroup analysis of mortality in the matched cohorts is presented in Figure 4. Participation in the KOS-MI Program was associated with improved survival in the following cohorts of patients: male, mostly <65 years old, patients with STEMI on admission, congestive HF, reduced ejection fraction (EF), hypertension, dyslipidemia, and AF.

DISCUSSION

In the current study, we report for the first time, the long-term, 3-year outcomes of the KOS-MI Program in a large cohort of patients. Participation in the program was associated with a significant reduction in mortality, MACCE, and the necessity of repeated revascularization. There was a strong trend toward a lower incidence of hospitalization for HF. These results were sustained after adjustment with PSM, thus proving durability and benefit of coordinated care beyond one year despite program termination. In

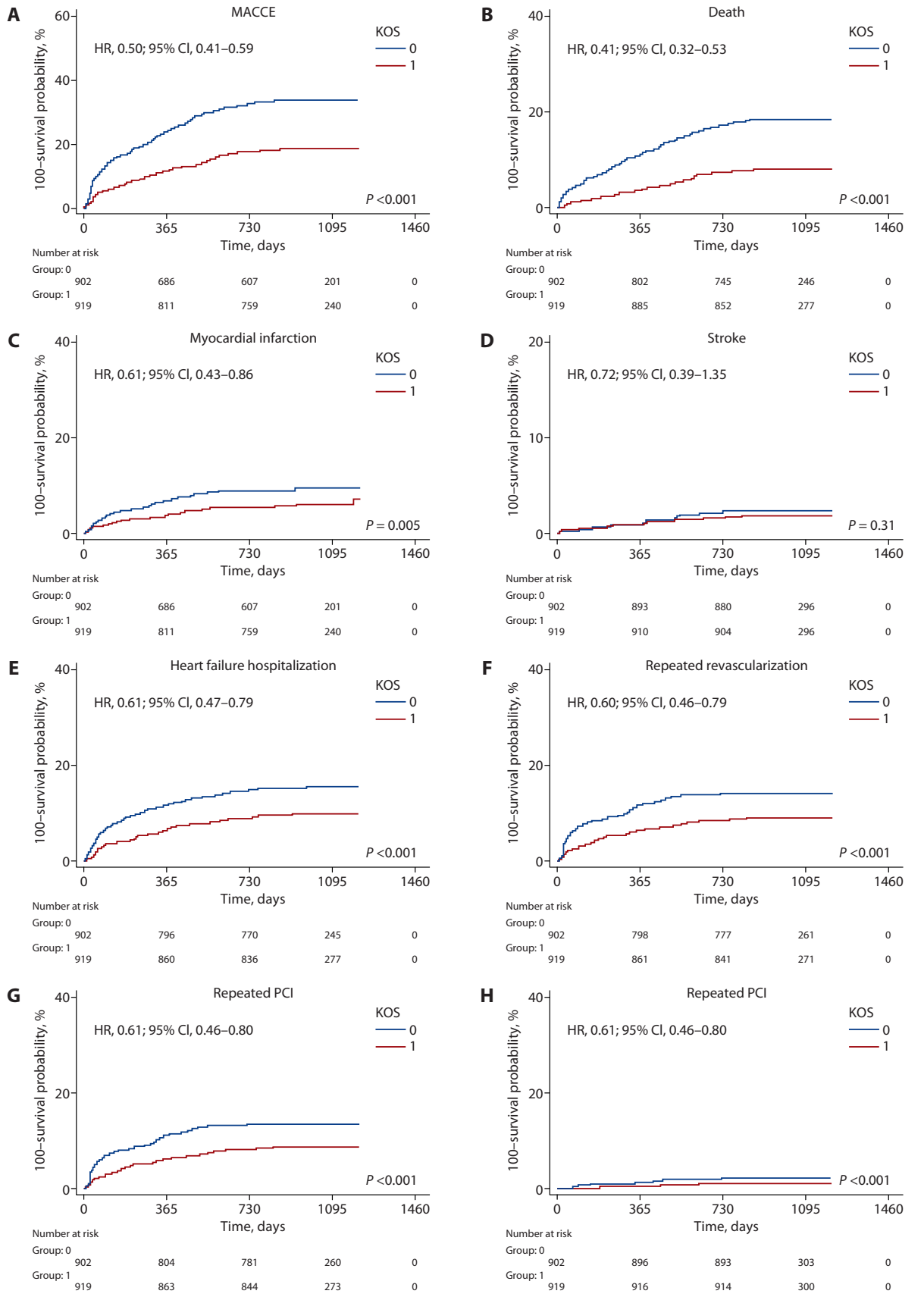

Figure 2. Three-year outcomes in the unadjusted population. Kaplan-Meier analyses with a log-rank test. **A.** MACCE-free survival. **B.** Overall survival. **C.** Recurrent myocardial infarction-free survival. **D.** Stroke-free survival. **E.** Heart failure hospitalization-free survival. **F.** Repeated revascularization-free survival. **G.** Repeated PCI-free survival. **H.** CABG-free survival

Abbreviations: CABG, coronary artery bypass grafting; CI, confidence interval; HR, hazard ratio; MACCE, major adverse cardiac and cerebrovascular events; PCI, percutaneous coronary intervention

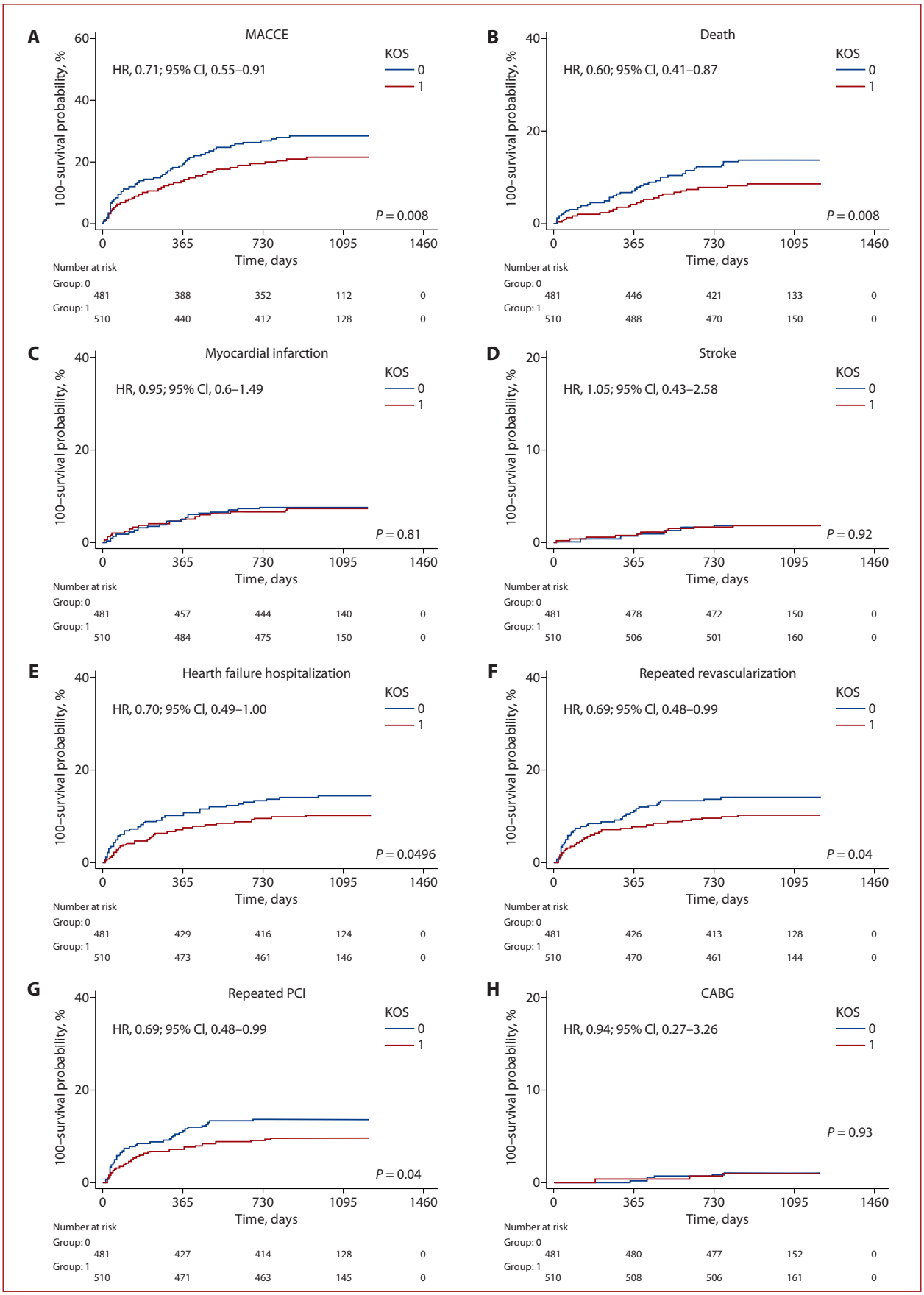

Figure 3. Three-year outcomes in the adjusted population. Kaplan-Meier analyses with a log-rank test. **A.** MACCE free survival. **B.** Overall survival. **C.** Recurrent myocardial infarction-free survival. **D.** Stroke-free survival. **E.** Heart failure hospitalization-free survival. **F.** Repeated revascularization-free survival. **G.** Repeated PCI-free survival. **H.** CABG free survival

Abbreviations: see Figure 2

Table 2. Baseline patient characteristics after PSM 1:1

	Control group n = 530	KOS-MI n = 530	Standardized difference	*P*
Age, median (IQR)	65 (59–72)	66 (59–73)	2.85	0.71
Male sex, n (%)	361 (68.1)	348 (65.7)	–5.21	0.40
STEMI/ /NSTEMI, n (%)	230 (43.4)/ /300 (56.6)	220 (41.5)/ /310 (58.5)	–3.82/ /3.82	0.53
Killip I, II, n (%)	516 (97.4)	516 (97.4)	0	1.0
Killip III, n (%)	4 (0.8)	3 (0.6)	2.3	0.7
Killip IV, n (%)	10 (1.9)	11 (2.1)	–1.35	0.83
Acute HF, n (%)	16 (3.0)	15 (2.8)	–1.12	0.86
Congestive HF, n (%)	94 (17.7)	93 (17.6)	0.49	0.94
Ejection fraction, %, median (IQR)	48 (40–55)	48 (40–54)	0.17	0.87
Acute kidney injury, n (%)	9 (1.7)	4 (0.8)	–8.57	0.16
Chronic kidney disease, n (%)	33 (6.2)	32 (6.0)	–0.79	0.90
Hypertension, n (%)	358 (67.6)	349 (65.9)	–3.6	0.56
Diabetes mellitus, n (%)	135 (25.5)	131 (24.7)	–1.74	0.78
Dyslipidemia, n (%)	350 (66.4)	346 (65.3)	–1.59	0.80
Active smoking, n (%)	120 (22.4)	100 (18.9)	–9.3	0.13
COPD, n (%)	19 (3.6)	18 (3.4)	–1.03	0.87
Prior MI, n (%)	75 (14.7)	72 (13.6)	–3.25	0.60
Prior PCI, n (%)	71 (13.4)	69 (13.0)	–1.11	0.86
Prior CABG, n (%)	22 (4.2)	26 (4.9)	3.63	0.55
History of stroke, n (%)	19 (3.6)	13 (2.5)	–6.61	0.28
Atrial fibrillation, n (%)	55 (10.4)	52 (9.8)	–1.88	0.76
Eptifibatide, n (%)	254 (47.9)	255 (48.1)	0.38	0.95
Coronary angiography, n (%)	527 (99.4)	527 (99.4)	0	1.0
PCI, n (%)	470 (88.7)	463 (87.4)	–4.07	0.51
CABG, n (%)	31 (5.9)	40 (7.6)	6.79	0.27
LM disease, n (%)	45 (8.5)	56 (10.6)	7.07	0.25
Multivessel disease, n (%)	353 (66.7)	349 (65.9)	–1.86	0.76
CTO, n (%)	47 (8.9)	46 (8.7)	–0.67	0.91
IVUS, n (%)	10 (1.9)	13 (2.5)	3.88	0.53
FFR, n (%)	4 (0.8)	5 (0.9)	2.06	0.74
Complete revascularization during first hospitalization, n (%)	221 (41.7)	217 (40.9)	–1.53	0.80
Second stage PCI, n (%)	57 (89.1)	80 (92.0)	9.94	0.54
Complete revascularization after two hospital admissions, n (%)	266 (50.2)	277 (52.3)	4.15	0.50

Abbreviations: PSM, propensity score matching; other – see Table 1

our study, patients undergoing rehabilitation at the KOS-MI Program had a lower risk of incidents as reported at baseline by significantly lower presence of comorbidities, representing the typical patient population at an early stage of enrolment. It should be noted that in this study, patients were enrolled at the very beginning of the program, which is why only 49% of patients were included in the study, however, at that point in time, it was one of the highest ratios. In addition to the limitations of the program, the main reason for the patient refusal to participate was the necessity to commute to ambulatory rehabilitation. Fragility and older age were also significant reasons for refusal. On the other hand, patients in very good condition did not see the advantages of participation despite the educational input. Other researchers had similar insights [11]. Later, patients with a higher risk profile were included and more patients were interested in the program.

Nevertheless, thanks to the large number of patients included in our registry, a comprehensive PSM analysis was performed which allowed for proper group balancing in all factors and significant bias reduction. The KOS-MI Program was related to a relative risk of death reduction by 41% at 1-year follow-up. At 3-year follow-up, mortality was significantly lower in the study group (8.6% vs. 13.9%; $P = 0.008$). There was also a significant reduction in MACCE (21.0% vs. 28.1%; $P = 0.008$), hospitalization for HF decompensation (10.4% vs. 14.4%; $P = 0.0496$), and repeated revascularization (10.2% vs. 14.4%; $P = 0.04$) in the KOS-MI group. No difference in stroke or MI incidence was observed. Improved survival associated with participation in the program was extensively reported in the following cohorts of patients: aged <65 years (HR 0.28; 95% CI, 0.11–0.71; $P = 0.02$), with STEMI (HR, 0.38; 95% CI, 0.21–0.7; $P = 0.003$), EF <30% (HR, 0.33; 95% CI, 0.11–0.99; $P = 0.05$), and AF (HR, 0.37; 95% CI, 0.17–0.80; $P = 0.01$).

This is the first study to report on the 3-year outcomes of the KOS-MI Program. Previously 1-year results were published by Wybraniec et al. [12], Wita et al. [13] as well as Jankowski et al. [14]. The European angiography registries report annual mortality in STEMI patients of approximately

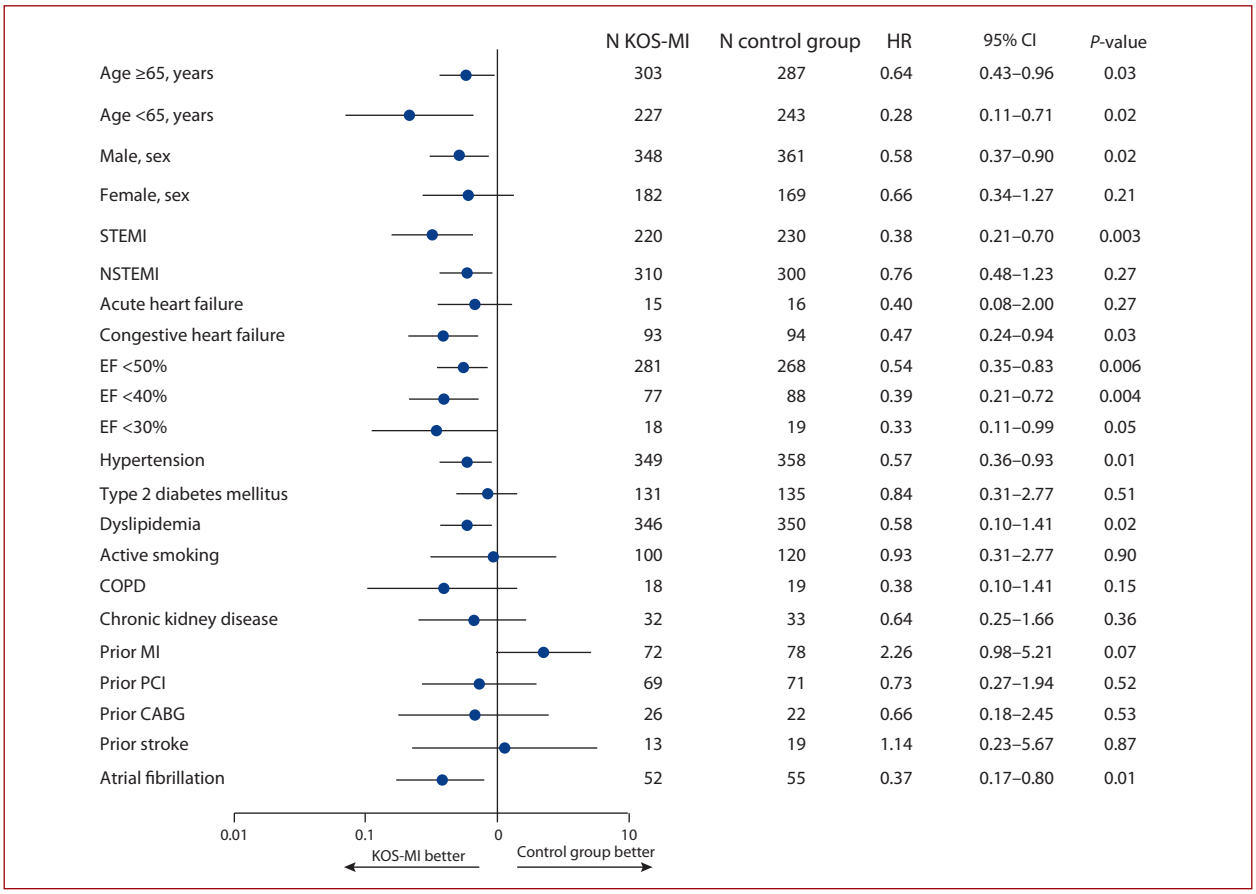

Figure 4. Mortality subanalysis in subgroups after propensity score matching. Forest plot with hazard ratios and 95% confidence intervals.

Abbreviations: COPD, chronic obstructive pulmonary disease; EF, ejection fraction; MI, myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; STEMI, ST-segment elevation myocardial infarction; other — see Figure 2

10% [15, 16]. According to the AMI-PL report, before the introduction of the KOS-MI Program, 1-year mortality of MI survivors in Poland after hospital discharge was 10.1% [3]. The median waiting time from discharge to particular intervention was as follows: staged PCI — 53 days, staged CABG — 65 days, first visit with a cardiologist — 95 days, electrotherapy device implantation — 132 days [4]. Moreover, only 22% of patients participated in comprehensive cardiac rehabilitation [3]. The KOS-MI Program enabled a significant reduction in waiting time. Every participating patient can start cardiac rehabilitation within 2 weeks after discharge. In our study, 79% of patients (n = 760) completed the program. Pokorney et al. showed that within a year after MI, EF is reassessed only in fewer than 70% of patients with EF ≤35% [17]. In the KOS-MI Program, echocardiographic evaluation is mandatory at 6–9 weeks from discharge.

In 2018, 1-year post-discharge mortality after MI in Poland was still high — 9.8%, however, it was the beginning of the program and not many departments participated in it [18]. In our study, all-cause 1-year mortality in the adjusted population was 4.3% in the study group and 7.3% in the control group (P = 0.04). These results are comparable to those described by Jankowski et al. [14] (4.4% and 6.0% respectively). Wybraniec et al. [12] also reported lower mortality in the program group (3.6% vs. 6.8%; P = 0.02), however, the control group was non-contemporaneous. Similarly, Wita et al. [13] corroborated the reduction in mortality in the KOS-MI group (5.4% vs. 8.7%; P <0.001). The reduction in MACCE was significant in all studies, however, the definition of MACCE was inconsistent. Jankowski et al. [14] reported the endpoint consisting of death, recurrent MI, and stroke at 1-year (10.6% vs. 12.0%; P <0.01) [14]. Wybraniec et al. [12] defined MACCE as a composite endpoint of death, MI, ischemic stroke, and additionally HF hospitalization (11.3% vs. 20.4%; P <0.001). The definition we used was a composite endpoint of all-cause death, MI, stroke, and repeated revascularization that occurred in 13.7% of patients in the study group vs. 19.3% in the control group (P = 0.02) at 12-month follow-up. According to Wybraniec et al. [12], there were significant differences between groups in terms of MI (4% vs. 6.8%; P = 0.04) and stroke occurrence (0.2% vs. 1.5%; P = 0.0496). We reported no such differences at one- and three-year follow-up. The rate of hospitalization for HF decompensation in the Wybraniec et al. study was comparable in both groups in the first year (5.1% vs. 7.2%; P = 0.16), which was similar to our findings (7.3% vs. 10.8%; P = 0.05). However, after a 3-year follow-up, the incidence of HF hospitalization was significantly lower for the KOS-MI group (10.4% vs. 14.4%; P = 0.0496). Recently, Kułach et al. [19] published 2-year outcomes of MI patients — both

participants and non-participants of the KOS-MI Program — in comparison to similar populations treated in the past (intention-to-treat analysis). MACCE was defined as a composite endpoint of death, MI, and HF hospitalization. There was a 30% relative risk reduction in mortality and 14% in MACCE occurrence.

Currently, there are not many studies assessing long-term mortality after MI in other countries. In the CRUSADE registry (US), the researchers showed long-term survival outcomes in older patients (>65 years old). Mortality was 24% at 1-year and 40% at 3-year follow-up [20]. Nadlacki et al. [21] published outcomes of long-term survival after MI in Australian and New Zealand populations between 2009 and 2015. Survival at 3 years was 76.2%. In a Korean study, researchers compared 5-year mortality of patients after MI undergoing CR with those without CR. In Kaplan-Meier survival analysis, the five-year survival rate was 96.9% in the CR group and 93.3% in the non-CR group. There was a significant reduction in the risk of mortality by approximately 59% in the CR group [22]. In longer follow-up, in the Soroka Acute Myocardial Infarction Project in Israel (follow-up period up to 10 years), mortality of patients after MI was 46.8% [23]. In our analysis, the mortality at three years was 8.6% in the KOS-MI group. Therefore, when compared to previously cited studies, this is a significantly better outcome similar to those reported at one-year follow-up. There was no significant increase in mortality beyond 2- and 3-year follow-up.

It should be noted that in the presented study, the KOS-MI group had better outcomes even after including complete revascularization in propensity score matching. It might be connected to the higher ratio of patients participating in rehabilitation (89.6% vs. 27.1%; P <0.001) and having more often at least one ambulatory visit (90.6% vs. 44.6%; P <0.001). This is in agreement with the analysis published by Wita et al. [13] in which CR and outpatient care were significant components affecting mortality.

Considering socio-economic factors, Shields et al. [24] published a systematic review of studies evaluating CR cost. The key variables were the risk of subsequent events and hospitalization, cost of hospitalization, intervention, and utilities. They suggested that CR is generally cost-effective. The KOS-MI Program reduces the incidence of MACCE, as well as the frequency of readmissions for decompensated HF. Both are well-known economic burdens for public health. Based on the results, the program is probably cost-effective, however, a detailed economic evaluation will be required in the future.

Besides the hard endpoints influencing the health prognosis and cost-effectiveness, the participants reported an increased feeling of safety and subjective improvement in their health status [25]. Education during the program boosts self-management, reduces anxiety, and promotes lifestyle changes. Additionally, the patients would like the program to continue beyond 12 months [25]. In our opinion, the KOS-MI Program should be a standard of care in every hospital.

Study limitations

The studied population excluded patients referred to the Intensive Care Unit and those who died in the hospital. This is an observation registry, thus the results are hypothesis generating. Additionaly, it is difficult to exclude all confounding factors, despite balancing with propensity score matching. Nevertheless, currently, the conduction of a large randomized clinical trial is nearly impossible as the program is in progress, and results from large cohorts are reassuring.

CONCLUSIONS

The combination of all modern and accessible methods — new invasive techniques of treatment, complete revascularization, cardiac rehabilitation, post-hospital scheduled follow-up visits, and easier access to services for the patient — improve the long-term prognosis of patients after myocardial infarction. Higher compliance to rehabilitation and ambulatory care was reported in the study group, which may explain improved outcomes. The effect of the KOS-MI Program persists for up to 3 years despite its termination at year one, which has not been reported before. In addition, presented data may indicate high cost-effectiveness of the KOS-MI Program due to a reduction in the number of serious cardiovascular events as well as readmissions for HF decompensation. A longer follow-up is needed to evaluate if the effects persist further and whether patients after MI should have additional care or rehabilitation beyond program termination.

Article information

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